REMARKS

Election/Restriction Requirement

Applicant has reviewed Examiner's restriction requirement of claims 1-29 in view of proposed invention I and invention II. Applicant confirms the election of invention I, as provisionally elected in conversation with Ralph Dowell on June 19, 2007. Applicant has withdrawn claims 19-26 and 29. Applicant reserves the right to file a divisional application at a later date to continue with prosecution of invention II, as identified by the Examiner.

Further, Applicant notes that the present application was filed with two claims numbered 22, thus necessitating the payment for 30 claims at the time of filing this application. Applicant has therefore cancelled the second occurrence of claim 22, added this claim as renumbered claim 30, and has withdrawn this new claim 30 as supposedly belonging to invention II. Applicant requests that the Examiner confirm that both the first and second occurrence of claim 22 are to be considered as belonging to invention II.

Applicant has reviewed the contents of Sheehan et al. and the corresponding 35 U.S.C. 102(b) anticipation rejection by the Examiner, in the Office Action dated June 28, 2007. Applicant does not agree with the interpretation of the Examiner with respect to both the present claims and the teachings of Sheehan. Applicant requests a telephone interview with the Examiner in order to discuss the merits of this case, once the Examiner has had time to review the below discussion of the Applicant.

Summary of Applicant's Claimed Invention

Applicant restates claim 1 of the present application for discussion purposes, with emphasis added:

1. An image processing system having a statistical appearance model for interpreting a digital image, the appearance model having at least one model parameter, the system comprising:

a multi-dimensional first model object including an associated first statistical relationship and configured for deforming to approximate a shape and texture of a multi-dimensional target object in said digital image, and a multi-dimensional second model object including an associated second statistical relationship and configured for deforming to approximate the shape and texture of the target object in said digital image, the second model object having a shape and texture configuration different from the first model object;

a search module for applying the first model object to said digital image for generating a multi-dimensional first output object approximating the shape and texture of the target object and calculating a first error between the first output object and the target object, and for applying the second model object to the image for generating a multi-dimensional second output object approximating the shape and texture of the target object and calculating a second error between the second output object and the target object;

a selection module for comparing the first error with the second error such that one of the output objects with the least significant error is selected; and

an output module for providing data representing the selected output object to an output.

In view of the above emphasized claim elements, Applicant brings to the Examiner's attention that *both* a *first* model object and a differently configured *second* model object are applied to the *same* target object in a selected digital image, resulting in the calculation of corresponding output objects. In turn, a *first* error between the target object and the first model output object is calculated and a *second* error between the target object and the second model output object is calculated. Finally, the first and second errors are compared to see *which* of the model objects provided a better approximation of the *same* target object, e.g. "the least significant error". The output object with the least significant error is then selected for representing the target object in the selected digital image.

In view of the above emphasized claim elements and discussion, Applicant has reviewed in detail the contents of Sheehan and failed to find any explicit (or even

hint of) disclosure relevant to the use of "a first model object" and "the second model object having a shape and texture configuration different from the first model object" in trying to determine an appropriate output object that best approximates the same target object in a selected digital image. Accordingly, Applicant considers the 35 U.S.C. 102(b) rejection of claims 1-6,9,11-13,15-18, and 27,28 as improper due to lack of support in the cited document of Sheehan. Applicant submits a proper interpretation of Sheehan for consideration by the Examiner.

Discussion of Sheehan et al.

Applicant submits that Sheehan describes how to build a *single* model and optimize that single model for automatically delineating the inner and outer surfaces of an organ that is present in a plurality of images, which are located on multiple planes in three-dimensional space. Sheehan's teachings are fundamentally different to Applicant's claimed invention that claims the application of *at least two different* models for (each) segmenting a single image.

For example, in reading Sheehan, it is obvious that *only* described is how to use a *single* model, see column 16, line 57 to column 17 line 3.

to the invention occur. If the error is less than the predefined threshold, the procedure proceeds to a block **242**, since it appears that the predicted images derived from the adjusted mesh model match the images of the patient's heart within an acceptable tolerance. Otherwise, the logic continues with a block **236**, which adjusts the mesh model to reduce the area between the corresponding features extracted from the predicted and the observed images.

To measure whether the last adjustment to the control vertices of the mesh model improved the match between features extracted from the predicted images and the observed images of the patient's heart, the mesh model is used to generate a new set of predicted images corresponding to the planes of the patient's image data. The feature

The above referenced lines of Sheehan describe how to 'fit' a *single* model to approximate the patient image. Furthermore looking at the figure 13, which is the figure that the text above refers to, block 236 clearly states 'Adjust *mesh model* to make features on predicted images more closely correspond to features on observed images'. Therefore, in Sheehan, Applicant argues that there is only *one* model involved, based on the "archetype shape and covariance data (block 210), a physics model of ultrasound reflection and attenuation (block 212),

generally as noted in Equations 1-6 above, and a structural model of cardiac anatomy 216", see column 14 – lines 32-36. Applicant notes that Sheehan should be interpreted as teaching the application of a *single* mesh model to *multiple* images.

In addition, Applicant has found other numerous passages throughout Sheehan that relate to a *single* model *only*, namely: 1) "*An ultrasound mesh model* in which a three-dimensional abstract mesh defining an archetype shape", see Abstract;

2) "The present invention uses a set of training data to derive *a mesh model* of an archetype heart that is subsequently adjusted so that *its shape* "explains" *the shape* of the patient's heart *in the observed images.*", see column 12, lines 8-11;

3) "*the mesh model* that is thus generated is *the abstract mesh*, which is manually designed to fit the ventricles of a variety of normal and diseased hearts in the population on which the set of training data are based", see column 13, lines 1-6;

4) "*an ultrasound mesh model* 214 is determined based on the archetype shape and covariance data (block 210), a physics model of ultrasound reflection and attenuation (block 212), generally as noted in Equations 1-6 above, and a structural model of cardiac anatomy 216", see column 14, lines 32-36 ;

5) "*the mesh* representing the archetype shape is rigidly aligned to each of the images produced by imaging the heart of patient 48", see column 14, lines 53-56;

6) "*the mesh model produces* a gray scale image 226 that predicts the appearance of the ultrasound image in plane 222. In this manner, *the mesh model is* used to produce predicted images corresponding to the images of the patient's heart made in specific imaging planes", see column 14 line 64 to column 15 line 2;

7) "*the mesh comprising the ultrasound image model is* rigidly rotated and translated, and scaled as necessary to more closely align the anatomical landmarks in the predicted images derived from *the mesh model* with the corresponding anatomical landmarks in the corresponding images", see column 15, lines 4-10;

8) "Automated border detection is performed by optimizing a fit of images predicted from *the mesh model*, to the patient's images", see column 15, lines18-20; and

9) "*The mesh model* is thus adjusted to fit the observed images for the patient's heart in an iterative process", see column 17 – lines 13-14.

Further, Applicant has reviewed the cited passage of Sheehan, relied upon by the Examiner, to purportedly show "a second model object ... different from the first model object", namely column 15 line 65 to column 16 line 25. Applicant respectfully brings to the attention of the Examiner that this cited passage also only discusses the use of one mesh model, namely "The *first non-rigid adjustment* initially implements a global spatial affine transformation of *the prototype mesh*" and "*Subsequent adjustments* are made to the position of the vertices controlling the shape of *the mesh*". These passages, in particular, emphasize the initial and subsequent optimization of only *one* mesh model for any particular set of feature images present in the patient images. Accordingly, in view of the above-noted Sheehan passages and Applicant's discussion, Applicant believes that Sheehan can only be interpreted to disclose one mesh model applied to anatomic landmarks present in patient images, which is fundamentally different to Applicant's use of *two* different model objects for interpreting a target object in a digital image.

Further, Applicant has reviewed Sheehan's teachings with respect to the comparison of the model and the images. Applicant can find no direct teaching of a selection module for comparing the error between the first model output and the target object) and the second error (between the second model output and the target object). Instead, Applicant can only find in Sheehan the comparison between a predicted image (of the one mesh model) and the patient image, *not* the comparison of the relative errors between two model objects, as presently claimed. For example, Sheehan refers to a comparison as "As shown in a block 232 of FIG. 13 and as explained above, *the mesh model* is used to predict the appearance of the gray scale image in each plane of the images made of the

patient's heart. The *predicted and observed images* are then compared, as indicated in a block 234", see column 15, lines 19-24, *emphasis* added. Accordingly, Applicant submits that a selection module (as presently claimed) is also not described in Sheehan.

Applicant has reviewed the Examiner's rejections for claims 2, 3, 4, and 9 and disagrees with the Examiner's findings, due to the above-discussed lack of teaching in Sheehan for the application of two model objects to a digital image. Accordingly, Applicant submits that claims 2,3,4 and 9 are also novel and inventive over the cited art.

Further, Applicant has reviewed the Examiner's rejections for claims 11, 12, 13, 15, 16, 17, 18 concerning a predefined characteristic. Applicant requests clarification from the Examiner for proper support in Sheehan for a "predefined" characteristic for aiding in diagnosis of a patient. Applicant can find no mention of a predefined characteristic, as claimed, in the cited passages of column 12, lines 8-61 and column 17 lines 41-48. Instead, Applicant argues that Sheehan only discloses the generation of an output comprising three-dimensional meshes, such that these meshes can be used to *calculate* cardiac parameters. Sheehan does not teach or even suggest the use of a predefined characteristic as claimed. Accordingly, Applicant submits that claims 11, 12, 13, 15, 16, 17, 18 are also novel and inventive over the cited art.

Applicant Submits that in view of the above discussion, the Examiner's rejection of claims 1-6, 9, 11-13, 15-18, and 27, 28 under 35 U.S.C. 102(b) is hereby overcome.

Discussion of Mitchell et al.

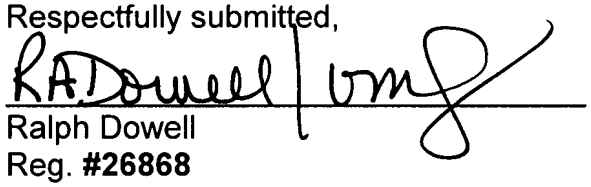
Applicant has reviewed the contents of Mitchell et al. and the correspondingly stated 35 U.S.C. 103(a) anticipation rejection by the Examiner, in the Office Action dated June 28, 2007. Applicant does not agree with the interpretation of the Examiner with respect to both the present claims 7-8, 10, 14 and the teachings of Mitchell.

Applicant submits that Mitchell describes how to use an AAM parameter's space produced by PCA to separate the class of pathology, specifically to discriminate healthy individuals from non-healthy individuals. In Mitchell, like in Sheehan, only one model is considered. Mitchell only mentions using one model to discriminate individuals, which is fundamentally different to what is presently claimed in Applicant's application concerning a first model and a second model. For example, Applicant refers the Examiner to the statement of "First, all model coefficients whether used for testing or training were derived from the *same* AAM model", *emphasis* added, see page 956 - section 4. On the contrary, in Applicant's claimed invention rejected in view of Mitchell, each model can contain a type of anatomy (e.g. healthy or not healthy), instead of both, and the presence of pathology can be determined based on which model best 'fits' in the patient's images.

Accordingly, Applicant submits that in view of the above discussion, the Examiner's rejection of claims 7-8, 10, 14 under 35 U.S.C. 103(a) is hereby overcome.

In view of the above, Applicant considers the currently amended claims as allowable and requests reconsideration to that effect. The Examiner is invited to contact the undersigned for any questions on the above.

Respectfully submitted,



Ralph Dowell
Reg. **#26868**

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